

Imagine How Agriculture may look like in 40 years!

For the first time, the 15th New Ag Conference & Exhibition held in Berlin hosted a technical session on Precision Agriculture. This reaffirms the commitment of New Ag International with this new paradigm of agriculture. Ten high calibre speakers made their way to the stage and covered most aspects of Precision Ag: The dilemma of Precision Ag scale: Is PA only viable in large-scale farming?: The use of weather information in PA: Different PA solutions using remote sensing data: Integral solutions implemented in the so called Farm Management Information Systems; the farmer's point of view on PA and, finally, why PA is not a success (yet)? Maybe Precision Ag is not the ultimate solution to agricultural problems, but it is here to stay. "In 10-15 years agriculture will be PA or it will not be!"

"PRECISION AGRICULTURE IS HERE TO STAY..."

"...and in 10-15 years agriculture will be Precision Ag or it will not be!" This key sentence was one of the main conclusions of the keynote by Prof. José A. Martínez-Casasnovas (University of Lleida, Spain), who presented a particular overview of "What's behind the name of Precision Agriculture". Precision Agriculture (PA) is a relatively new paradigm in agriculture and farmers and technicians are starting to ask many questions: when does PA begin to make sense? How can we start implementing PA? How can we know the causes of within-field spatial variation? Is PA the ultimate solution to agricultural problems? "The first time I heard about Precision Ag was in 2003" said Prof. Martínez-Casasnovas. "In that time I was asked to deliver a course on Precision Ag for technicians but I had never heard about that term. In 2003, and for 10 years, I had been involved in teaching and research about the application of Geographical Information Systems and Remote Sensing technologies to soil erosion mapping and land evaluation, but not specifically to agriculture or Precision Ag". Actually, the first documents about precision or smart farming or agriculture appeared about 1995 (see the Precision Ag Corner published in the November 2016 issue of New Ag International). Since then, they have exponentially growth until today. And this tendency goes on. This, together with the aforementioned advances in technology led to define the new paradigm of

Precision Ag as "the production based on the analysis of crop/soil spatial variability and its differential management to optimize returns on inputs while minimizing environmental impacts".



Precision Ag is not a novel concept since farmers and technicians have always known that fields are variable, and therefore crop yields and quality. What happens is that today new technologies exists and are affordable enough not only to measure the spatial variability of crops and soils but also to automatically apply agricultural inputs at different rates (e.g. fertilizers, pesticides, irrigation) or to perform other types of management actions". In parallel, the intensification of agriculture since the advent and massive expansion of mechanization has led to an increasing awareness about the influence of agriculture on environmental pollution.

PROF. MARTÍNEZ-CASASNOVAS

WHEN PRECISION AG BEGINS TO MAKE SENSE?

This is a big question that farmers or technicians ask when commercials try to sell PA services/products or when people attend courses or conferences about PA. For example, "Is my field big enough to return the investment in PA practices? Nevertheless, what few people realizes is that PA is not only a matter of size but a matter of variability and of how this variability is spatially structured (Figure 1). Then, the question could be reformulated as: Is my field variable enough and, if so, is variability structured in a way allowing the investment in PA practices to be returned?

HOW CAN A FARM START IMPLEMENTING PRECISION AG?

One of the first options is through yield monitoring. Actually, the availability of yield monitors since the 1990s, together with the possibility of georeferenced data collection using GPS or GNSS (see the Precision Ag Corner published in March 2017), is considered by many as the starting point of PA. However, high-resolution and multi-spectral satellite images soon appeared afterwards, making it possible to map the vegetation vigour prior to the harvest and to analyse the temporal spatial variability changes in detail. In addition, the availability of multi-spectral and hyperspectral cameras on-board aeroplanes, and nowadays in drones, have allowed higher spatial resolutions and the computation of a wide range of spectral indices to know specific characteristics of vegetation (e.g. chlorophyll content, water stress). These spectral

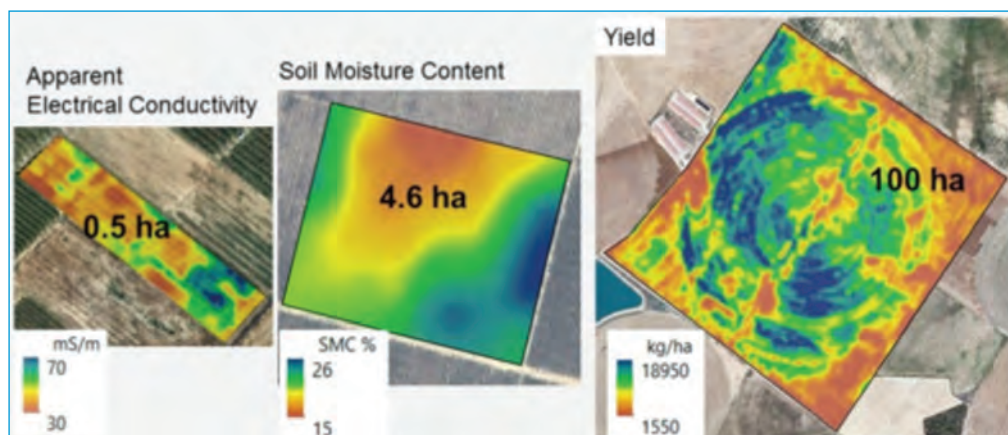


Figure 1: Maps of properties in fields of very different size showing spatial variability. After knowing the existence such variability, the implementation of PA practices will depend on the importance of having a homogeneous product in yield and quality and in the ratio cost/benefit. Precision Ag is not only a matter of size but a matter of the variability and how it is structured.

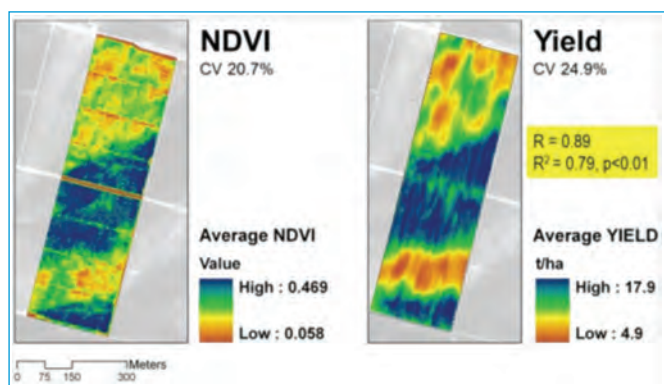


Figure 2: Comparison of a spectral vegetation index derived from a satellite image (Quickbird-2, 2.7 m/pixel) (left) and a yield map derived from a yield monitor in a vineyard. The maps represent averages of three consecutive years and show the similar intra-field spatial variability of both properties. Nevertheless, the images to compute the vegetation indices were acquired about one and a half months before harvest. The coefficient of correlation value (R) indicates the correlation between the spectral index and the yield and ranges from 0 to 1.

indices have shown, in most cases, the ability to predict yield (Figure 2) or even quality properties (e.g. wine grapes). Because of that, these indices are especially interesting in planning differential or site-specific actions to achieve more homogeneous yields or quality of the final product along the crop cycle. As important or more than knowing the existence of intra-field spatial variability is to know the causes.

HOW CAN WE KNOW THE CAUSES OF SPATIAL VARIATION?

Probably, the spatial variation is caused by different soil properties across the fields. On-the-go soil sensing through the measurement

of apparent electrical conductivity is perhaps, at present, the best option to map the variation of soils with different properties, although they must be “discovered” through soil sampling in the distinct zones of variation (see Figure 1, left image). In addition, it is very important to know the history of the field, particularly in the last decades, in which agricultural land has suffered a huge transformation in many areas around the world to enlarge fields to favour mechanization.

I have a map that tells me how variable my field is (e.g. vigour, yield). Now what? This is a key question in the Precision Ag cycle that, if not properly addressed, can

make PA projects fail. This is in fact the bottleneck of many service companies selling just yield or crop vigour maps, or in other words “a nice drawing of a field painted in different colours”, without any piece of advice based on agronomic expert knowledge. For this reason, Prof. Martínez-Casasnovas emphasized in his talk that “PA is rediscovering agronomy and for that agronomists with specific education in PA technologies are needed”. “We are passing from well-established uniform recommendations (e.g. a uniform dose of fertilizer, pesticide, water, etc.) to have to take decisions about site-specific recommendations based on previous knowledge of the spatial variation and its causes. This requires not only a “coloured map” but expert agronomic knowledge to integrate information about crop requirements, crop status, soils, fertilizer and other inputs characteristics”.

Precision Ag is not new in its concept, but technology now exists and is reasonable affordable for its implementation. “Be aware that benefits may be offset by the costs of adoption. So, be prudent in adopting and using PA technologies. Do not expect results overnight, just a learning curve. It may take several seasons to see and confirm expected results. Measuring crop spatial variability is

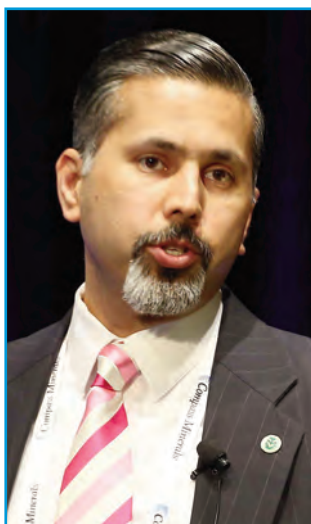
important but more important is to know and/or understand its causes, and for that, expert knowledge (mainly agronomic) is needed”.

PRECISION NUTRIENT MANAGEMENT FOR SMALL AND LARGE SCALE FARMING SYSTEMS

Precision nutrient management was presented in the 15th New Ag International Conference as one of the main challenges that agriculture will have to face in the short term to feed the growing world population. The presenter, one of the main world authorities in Precision Ag: Prof. Raj Khosla (Colorado State University, USA). He has over 300 publications with main research focus on “Management of in-field soil and crop variability using geo-spatial technologies for precision management of crop-inputs across large and small-scale farming systems”; and, among others, founder and founding-President of the International Society of Precision Agriculture.

“We are facing global challenges and for that we need global solutions”, Prof. Khosla said. However, he noticed that Precision Ag is about 25 years old but still more than 50% of the arable land in the world is fertilized by hand and this is empowering agriculture. “Can we do better than this in the 21st century?” In the last 25 years there has been a revolution in agriculture to find solutions to make better decisions. Many innovations have taken place and today we cannot imagine how agriculture may look like in 40 years from now. “Think about the GPS system and compare how a receiver was in 1976 and how it is now: less than the size of a coin!”

Prof. Khosla emphasized that humans have been doing agriculture for a long time and what we are doing at present with digitalization of agriculture is just looking at it through the window of computers. All the information is in cloud servers. Any activity performed on



"Precision Ag is best described by five R's: use of Right inputs, at the Right time, in the Right amount, at the Right place and in the Right manner".

Nevertheless, as Prof Khosla said, "there is NO handbook on Precision Ag out there that says you have to use complex and expensive large machines"

PROF RAJ KHOSLA, COLORADO STATE UNIVERSITY (USA).

farms can be georeferenced by GPS and can be integrated in to help farmers to take decisions.

Prof Khosla then captured the attention of the audience with the paradox of the average yield and variability. Usually farmers look at

average yields per hectare. "However, do you know how many pixels of a yield map match the average yield of the field?" The answer...: only 2%. Actually only this percentage of pixels matched the mathematical average yield in grain field belonging to the best farmer of the 2015 in the USA. The message: "we have been looking at average numbers for too long but if we do so we are paying attention only to small parts of our fields and then we are losing money". This, translated to management operations, such as fertilization, means that if we consider average numbers we will be over-fertilizing and/or under-fertilizing the major part of our fields, losing fertilizer, potential productivity and, definitely, money.

How large is within-field spatial variability? This could be stated as the paradox of size. A study conducted in small-scale agricultural fields of the North China Plain to determine the potential of savings in N fertilizers in wheat, demonstrated that N supply by farmers varied significantly, both within individual fields and across fields. Then, we could say that Precision Ag is not a matter of size but of natural or induced variability. Potential field-average optimum N

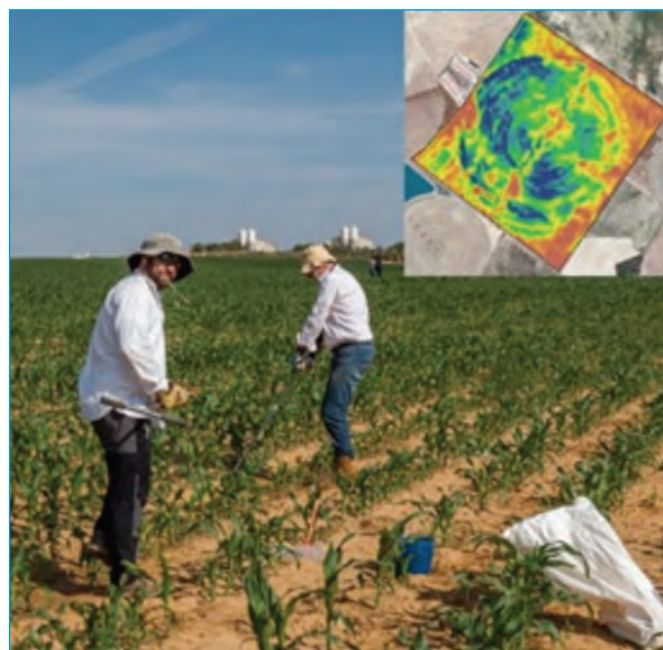


Figure 3: Precision Ag is based on technology to know the spatial variation of crop performance and/or soil characteristics. Nevertheless, field work is needed to know the real causes of the spatial variation or to take decisions about differential management actions. This picture shows the targeted soil sampling after the soil characterization and classification from an on-the-go sensor to determine the amount of nitrates in different zones of a maize field to decide about the sidedress N rates.

rates showed that field-specific N management could be a practical management strategy in those small-scale cropping systems. Compared with typical farmer practices, site-specific N management had the potential to save 128 kg N/ha, preventing under- or over-fertilization in these fields.

"Precision Ag is best described by five R's: use of Right inputs, at the Right time, in the Right amount, at the Right place and in the Right manner". Nevertheless, as Prof Khosla said, "there is NO handbook on Precision Ag out there that says you have to use complex and expensive large machines". However, there can be different, better low-cost solutions, that would be of interest to small-scale farming. This extends the possibilities of Precision Ag to not only developed countries and/or big farmers that can pay technology. "Precision Ag is not a solution for all the problems; it is just a tool to help us improve. Nevertheless, we need to focus on coupling human potential with machines and not technology alone".

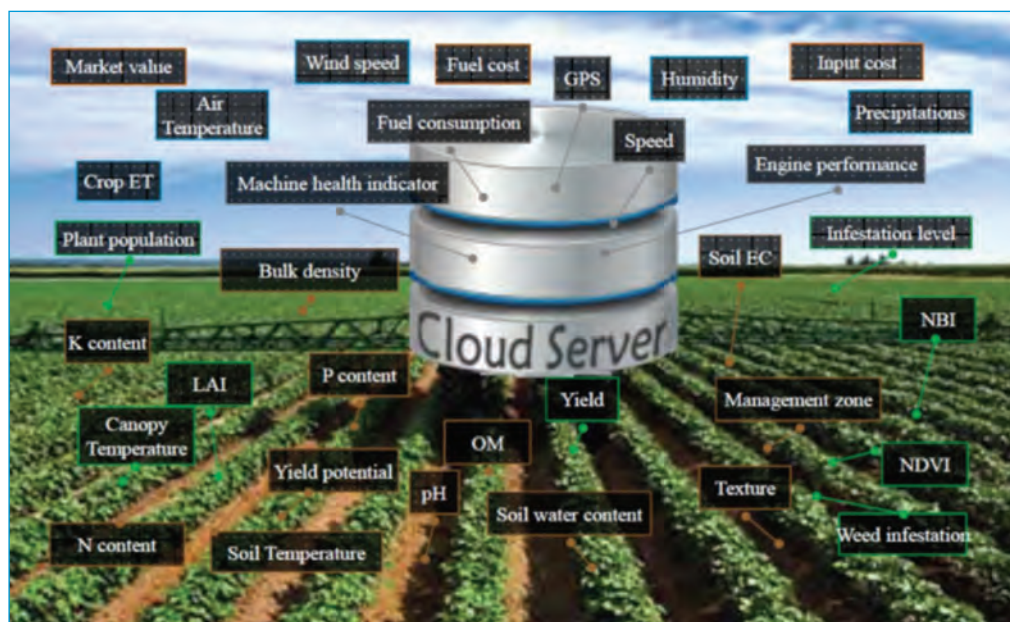


Figure 4: "The digitalization of agriculture is just looking at it through the window of computers and all the information will be in cloud servers". Prof Raj Khosla.

PRECISION WEATHER INFORMATION FOR ANY FARM

Dr Karl G. Gutbrod (CEO, Meteoblue AG, Switzerland), was exposed to Precision Ag for the first time in around 1995. "Since then, PA has been based on collecting and interpreting data on crop and

soil spatial variability, mainly". However, "we still know little about the weather". Meteoblue forecast were initially developed at the University of Basel based on models of NOAA/NCEP. It was founded as a company in 2006, to ensure reliable operational forecasts and to better service the industry; an independent commercial computing infrastructure and product development was established. Starting in May 2008, the company offers local forecasts for more than 5 million places worldwide, using proprietary modelling to generate locally adapted forecast for surface and atmosphere.

As we all know, there are technologies for simulating weather that have been improving during the last 30 years in accuracy. For example, the site-specific forecast for 1-3 days is very good, although some inaccuracies remain (thunderstorms, precipitation amounts, micro-climate). The current accuracy for temperature forecast is about 1.5 °C, although the error increases with distance to meteorological stations. Nevertheless, and in the words of Dr Gutbrod, "agriculture has worked without weather data for more than 5,000 years". Then, "why weather data is necessary today? For what can precise weather-



"PA has been based on collecting and interpreting data on crop and soil spatial variability, mainly". However, we still know little about the weather!"

DR KARL G. GUTBROD
(CEO METEOBLUE AG, SWITZERLAND)

Dr Gutbrod also presented other examples of precise weather forecast to evaluate spring frost risk in fruit plantations or to predict grain yields for productivity tracking. With that, he tried to demonstrate that there is a huge opportunity of using precise weather data to add value to agriculture. The cost to serve 1 point/year with simulated and quite accurate data (e.g. 85% accuracy) is estimated in €20 (excluding the cost of distribution), which may be accessible to a wide range of farms. Finally, Dr Gutbrod aimed at starting a new era for science-based farming with weather data, as well as to make top quality weather available for every farm worldwide by 2020. "Useful weather data is there everywhere, since 1984. Use it!"

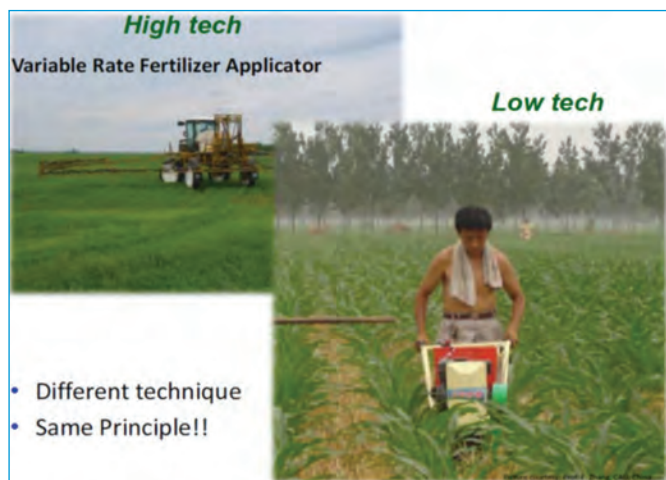


Figure 5: There are different solutions for Precision Ag, not only based in high tech. Also small-scale farming, even in developing countries may apply low cost solutions to improve the application of fertilizers and the yield. Prof. Raj Khosla.

er data be useful?" One answer is the use of simulated weather data to perform instant crop risk assessment and crop production tracking. For example, sidedress nitrogen applications in grain crops can be partially lost (25-50%) in one week if there is no rainfall after the application. This can suppose a loss of money both in N and in grain yield. In these cases, rainfall forecast may allow better planning of N application to avoid losses.

REVOLUTION FOR PRECISION FARMING ON THE DOORSTEP-LPWA

Pessl Instruments is a company based in Austria that has been producing measuring instruments for more than 30 years for informed decision-making. Among other: weather stations, loggers for soils moisture and hydrology, Internet irrigation controllers, frost alerts, etc. The company produces new weather stations connected in network with a new way of communication: the LPWA (Low-Power Wide Area network). Gottfried J Pessl (CEO, Pessl Instruments GmbH, Austria) said that "LPWA is a technology that is specialized for inter-connecting devices with low-bandwidth connectivity, focusing on range and power efficiency. Batteries can last 10 years or more and it is a low cost technology, lower than mobile networks. With it, many things can be connected to build a system of systems".

The first case connecting weather stations using Narrow Band in Internet of Things (IoT) was presented recently in the Mobile World Congress in Barcelona 2017. This now opens new opportunities of building a new type of Farm Management Systems (system of

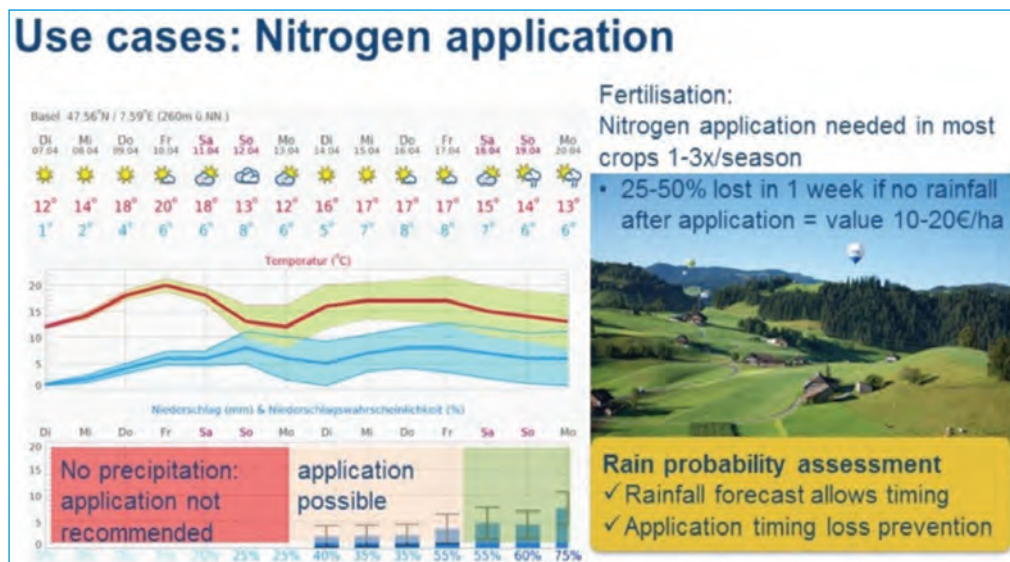


Figure 6: Precision weather information can be useful in preventing losses after N sidedress application in grain crops. For example, it can be N loss of 25-50% if there is no rainfall after one week of the application. This can represent 10-20 €/ha plus the lower yield because the N loss. K Gutbrod



"LPWA technology is predicted to be 53% of all Machine-to-Machine (M2M) connections by 2024".

This means that, with decreased power requirements, longer range and lower cost than a mobile networks, LPWA are thought to enable a much wider range of M2M and Internet of Things (IoT) applications."

GOTTFRIED J. PESSL (CEO, PESSL INSTRUMENTS GMBH, AUSTRIA)

systems), which connects weather data, seed optimization, irrigation, farm equipment for description and diagnosis of what is happening, modelling a prediction and make prescriptions. In other words, a system that converts data in information to take decisions and actions.

One of the products presented by Mr Pessl was iMETOS, a weather monitoring and forecast modelling device that combines measurement of weather parameters and delivers models of 7 days localized forecast. Another product was a weather station with temperature, humidity,

rainfall, global radiation and wind speed used to calculate the potential evaporation (ET0). It also incorporates a multiple volumetric soil moisture sensor with measures at every 10 cm, or a single sensor for measuring volumetric soil moisture, electrical conductivity and tempera-

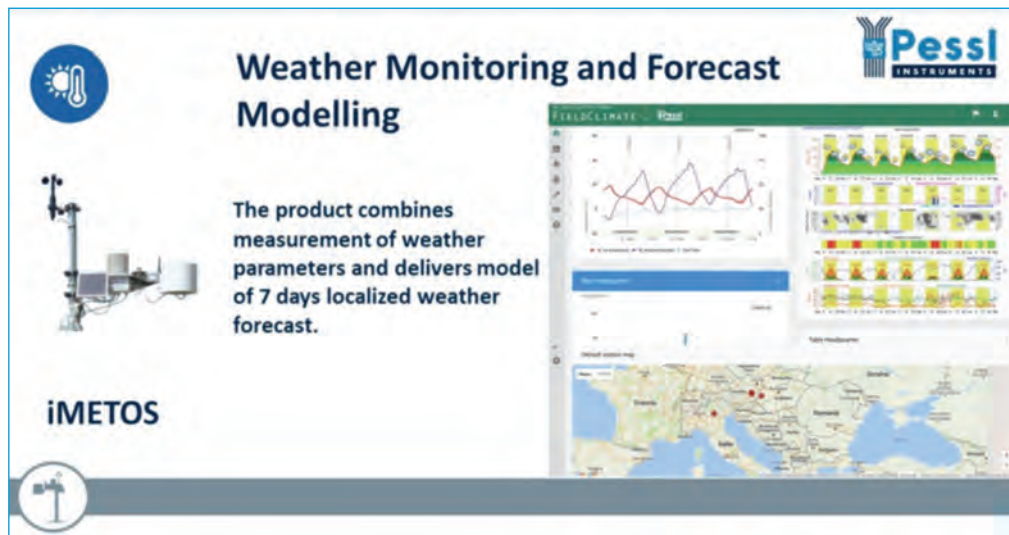


Figure 7: iMetos. One of the products of Pessl Instruments that can work in network to provide weather data in real time and forecast modelling.



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ture. This information is incorporated in an application (Irrimet) that provides a simple water balance. The water balance is calculated as function of ETc, rain and rain efficiency, type and efficiency of irrigation system and irrigation events.

Other applications and services from these meteorological stations include "plant disease risk modeling". The models are calculated with measured and with forecasted weather data. "Today we are able to offer models for many tree fruits,

soft fruit, vegetables and arable crop". "Real time work tracking and alerting", a service that allows knowing where the machines are working, which implement is attached, which weather conditions during the work and with automatic

warning of abnormalities. "Crop monitoring", with field cameras that show the field conditions, growth and weather in the fields remotely. "Insect monitoring", with traps with built-in camera and Internet connection, to determine the best spray date. "Realtime 4D crop growing decision support eco-system", with full integration of satellite imaging (optical, radar, climate monitoring); local ground weather monitoring and forecasting; plant and insect monitoring; and soil (moisture, fertility) and irrigation monitoring. After all, the idea is to provide end-to-end solutions based on local networks of connected sensors in the field, which transfer the data to supra-network infrastructures to serve the end user segment. This allows different types of business solution concepts: independent farm solutions, private network platform solutions or country network platform solutions that the company with local partners can offer.

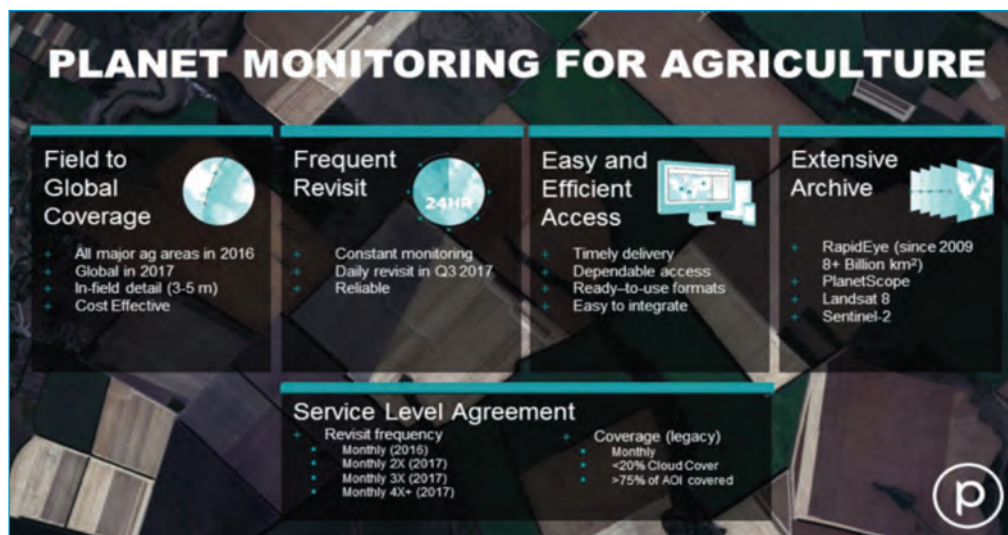


Figure 8: The main components of Planet's Monitoring solution and their main features based on different constellations of satellites, included the own PlanetScope. "The most important fact to consider is that this daily and updated data may enable immediate action".



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SATELLITE IMAGERY IN AGRICULTURE: FIELD-LEVEL DETAIL ON A GLOBAL SCALE

This was the Planet's monitoring solution in support of Precision Agriculture presented by Karsten Frotscher (Product Marketing Manager, Planet, Germany). The aim: to overcome the challenging transition from traditional medium resolution imagery to high resolution tasking for Precision Ag.

Planet is a SF-based data and analytics company that manufactures and operates its own fleet of satellites, the PlanetScope constellation. In 2015, Planet acquired BlackBridge and its RapidEye constellation and, more recently, Terrabella's Skysats. "The mission is to image the entire planet every day to make global change visible, accessible and actionable".

Although satellite imagery has been available for 45 years, one of the main problems for companies is that they are not even leveraging them yet. Up to now, users could get global daily coverage, but at a very low resolution such as from MODIS. In addition, it was possible to acquire medium to high resolution, but typically only getting low coverage from tasking satellites and/or taking days, sometimes

weeks to gain access to data, and expensive. In summary: limited coverage, low revisit rates and/or slow and inefficient access. "This was limiting the possibility of frequent monitoring of our area of interest and the creation of new business workflows, processes, and value". Planet's solution is to provide daily coverage of the world with a detail of 3-4 m/pixel. Recently (February 2017) Planet launched 88 "PlanetScope" satellites. The complete PlanetScope constellation will be of approximately 120 satellites able to image 150 million km²/day in the RGB and NIR spectral bands. "We don't need to "task" our satellites, since they are always collecting imagery around the Earth. You don't need to wait weeks for an image, since they're always up-to-date and available through online tools".

In his presentation, Mr K. Frotscher also pointed out that massive image capturing is one thing, but providing easy and efficient access is equally important in support of time-critical in-season applications in agriculture. For that, the company has built a data pipeline in the cloud, which automatically looks at the firehose of data, geo and ortho-rectifies the individual images, creates a machine readable catalog and makes the data set available programmatically through Application Programming Interfaces. In conclusion, "by providing daily global imagery and putting in the hands of farmers in a matter of hours not days, we're going to improve decision support for farmers. We're going to help them understand cause and effect relationships between environmental factors and farm management decisions".



"Our mission is to image the entire planet every day to make global change visible, accessible and actionable."

KARSTEN FROTSCHER (PRODUCT
MARKETING MANAGER, PLANET,
GERMANY)

BIOPHYSICAL PARAMETERS FOR A PRODUCTIVE AND SUSTAINABLE AGRICULTURE

"We are providing satellite imagery services for more than 30 years. Nevertheless, for effective applications of remote sensing in Precision Ag we need to overcome the limi-



"Airbus is one of the main providers in Europe in terms of services based on remote sensing, having at present about 18,000 farmers in 9 countries as clients, covering 800,000 ha."

CHARLOTTE GABRIEL-ROBEZ
(AGRICULTURE MARKETING MANAGER,
AIRBUS DEFENCE AND SPACE, FRANCE)

tations of low robustness vegetation indices, or sensitive to light conditions and that require ground measurements calibration to access biomass. This can be achieved through biophysical parameters derived from images and associated with agronomic expert knowledge for final farming recommendations". These are some of the main conclusions of the presentation by Charlotte Gabriel-Robez (Agriculture Marketing Manager, Airbus Defence and Space, France) in the Technical Session of Precision Ag, in which she talked about the "interest & benefits of biophysical parameters for a productive and sustainable agriculture".

Today there are multiple remote sensing data types and resolutions for every need: high/low spatial resolution, sensors with different spectral resolutions (number of bands), higher temporal resolutions of revisit times, etc. Nevertheless, most of the solutions in agriculture have been based in relative evaluation of differences in vegetation development through spectral indices, which are sensitive to light conditions, viewing angle and other parameters. Because of that, the

purpose of Airbus is to provide farmers and technicians with biophysical parameters allowing absolute quantification of the biomass and nitrogen, making unnecessary ground measurements. An example of these imagery derived biophysical parameters mentioned by Mrs Gabriel-Robez was an index-based insurance to decide possible compensations to farmers for grassland production. Or the advice to farmers for nitrogen saving in wheat growing to increase protein and yield based on detection of nitrogen status and biomass quantification. This allows saving between 10 to 17% of nitrogen and increasing yield by 10-15%. This type of services are consolidating Airbus as one of the main providers in Europe in terms of services based on remote sensing, having at present about 18,000 farmers in 9 countries as clients, covering 800,000 ha.

A REMOTE SENSING SYSTEM IMPLEMENTED FOR USE IN WOODY CROPS

Another solution for Precision Ag based on remote sensing was presented by Mauro José Bernal González (Manager of Crop Scan, Bioibérica SA, Spain). The tool is Crop-Scan®, a crop stress diagnosis technology that can diagnose each tree.

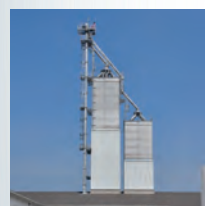
Initially (1975), the company Bioibérica was dedicated to the investigation of biomolecules with significant biological and therapeutic properties. Gradually the company began to specialise in the production of these type of biomolecules for the pharmaceutical, veterinary and agricultural industries. At present, it produces over 100 products designed to improve the health of people, animals and plants and we are present in more than 65 countries. "Aware that plants also are living organisms, since 1986 Bioibérica began to provide solutions to combat plant stress due to different causes: weather conditions, salinity, pests, diseases, transplants, pesticides",



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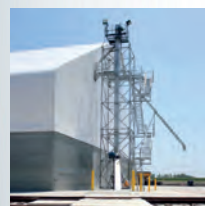
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Mr Bernal González said. All these are factors that have a negative impact on the quality and quantity of harvests. Then, the plant health strategic lines of the company were presented: a) the production of natural products based on aminoacids, b) biological attractants for fruit crop fly pests and c) stress diagnosis based on remote sensing.



"Crop-Scan® is the first crop scanning service from manned aircraft to diagnose the stress before the farmer can detect the symptoms visually".

MAURO J. BERNAL GONZÁLEZ
(MANAGER OF CROP SCAN,
BIOIBÉRICA SA, SPAIN)

The stress diagnosis line of Bioibérica is based on Crop-Scan®, "which is the first crop scanning service from manned aircraft to diagnose the stress before the farmer can detect the symptoms visually". Crop-Scan® was developed in cooperation with the Spanish National Research Council (CSIC), the largest public institution dedicated to research in Spain and the third largest in Europe. The tool is based on thermal and hyperspectral cameras installed on manned aircraft. The images enable various maps to be elaborated, with pixel details starting from "5 cm". These maps can indicate:

- The temperature of the crop and its hydration through the computation of the Crop Water Stress Index (CWSI): water content map.
- The chlorophyll content, which



Figure 9: Example of nitrogen savings and increase of yield and protein content based on differential application of nitrogen according to biophysical parameters derived from remote sensing images.

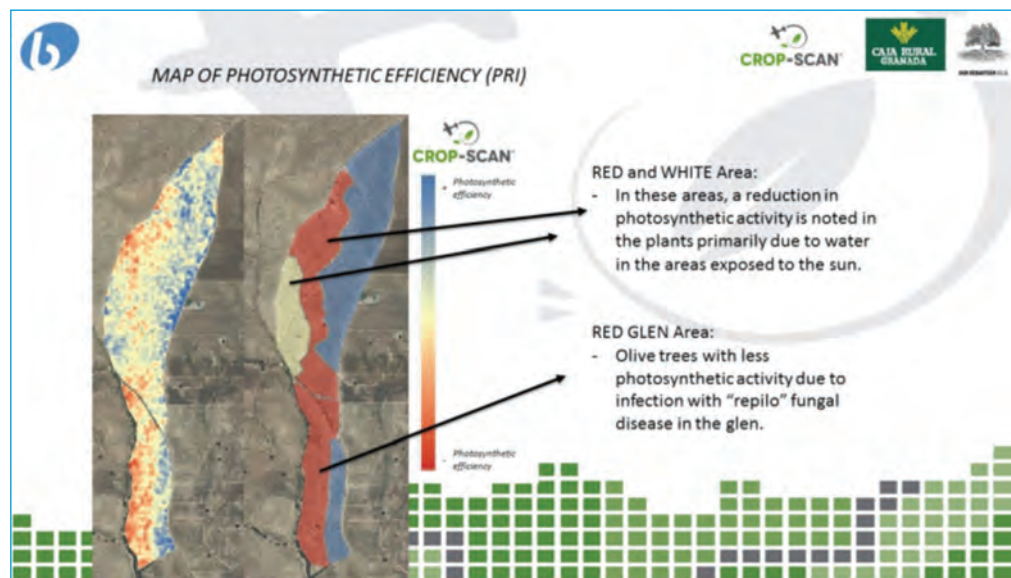


Figure 10: Example of Crop-Scan® product. The image shows a map of the photosynthetic efficiency of an olive grove located in Granada (Spain) (PRI index) (left) and the zoned map with the associated interpretation (right). In this case, observed differences were due to water stress of trees located in south oriented slopes and the affection of a fungal disease (*Spilotea oleagina*).

can be related to nutritional deficiencies and the leaves' nitrogen, iron or zinc content, through different spectral index (TCARI, MCARI, OSAVI indices): chlorophyll map.

- The productivity, quantity, quality and development of the vegetation, through visible and NIR reflectance (NDVI and LAI indices): vigour map.
- An index related to photosynthesis and therefore to the fruit quality parameters, such as sugar and acidity content (PRI index): map of photosynthetic efficiency.

Initially Crop-Scan® is designed for use in woody crops, such as olive trees for example. In this respect, a case study of an olive grove located in Granada (Spain) was presented. For that, different types of images with 15-20 cm resolution were acquired: vigour, chlorophyll content, water stress and map photosynthetic efficiency were created. The example showed how, depending on the type of sensor used, it is possible to delineate zones with distinct problems of water stress, vegetation development, etc., and where different recommendations could be made. "The farmer can

have a reliable and rapid photograph of "the state of each tree" on large plots, with a cost between 12 and 20 € per hectare and receiving the report in less than 72 hours. In addition, technical support from agronomists to aid in interpreting the results is given".

TURNING DATA INTO INSIGHT FOR FARMERS

"Each farm is different. Every field is unique", said Mr Martin Rand (Commercial Director of VitalFields, a European subsidiary of The Climate Corporation, Estonia). "Because of that, the Climate

Corporation created Climate FieldView™ to make data-driven decisions to maximize returns on every piece of land”.

The aim is to help farmers sustainably increase their productivity with digital tools, connecting information from different sources (field-soil-atmosphere) to take right management decisions. Mr Rand remembered that yield is a function of several factors as genetics, environment and farming practices plus “variability”. A study of the University of Illinois about corn production states that, apart from the variability of weather and climate, more than 2/3 of the biggest influencers of yield in the field are controllable factors. And today, as Mr Rand said, “with Precision Ag tools, there is a big opportunity to narrow field variability”.

One of these solutions can be FieldView™, a centralized field data management system that allows having all field data in one place. It allows collection, storage and display field data in one easy-to-use digital platform that can be accessed from the field, office or home. The tool also helps to ana-

lyze the crop performance by soil type, by field, or even by field regions; and maps side-by-side to better understand field variability. Climate FieldView™ uses a proprietary process to deliver consistent, high-quality satellite images so farmers and technicians can identify in-season challenges and take action to protect yield. Customized plans for each field to manage variability and maximize yield with variable rate planting prescriptions and nitrogen monitoring can also be performed with the tool.

PRECISION AGRICULTURE: THE VISION OF A NETWORK OF COOPERATIVES

How is the real vision of Precision Ag from the point of view of farmer organizations? Thierry Darbin (Precision Agriculture Chief Officer, InVivo Agriculture, France) offered this point of view from the testimony of a network of 31 cooperatives associated with the InVivo Group. InVivo Group is the leading French agricultural cooperative group, joining 220 member cooperatives in 31 countries around the world and being organized around four fields of expertise: Agriculture, Animal Nutrition and Health, Retail and Wine.

French agricultural land supposes about 18 Mha of arable land and 10 Mha of perennial crops. Of those, and according to figures presented by Mr Darbin, only 17% of the farmers use decision support tools to adapt their practices according to weather and crop conditions, and only 14% of the farmers use remote-sensing data to adjust nitrogen fertilization on a yearly basis. Yield maps are much less frequent, being used only by 8% of the consulted farmers. However, 40% use parcel-based management software's, which is a promising number to later adopt other PA practices.

“Overall, farmers feel that they have reached a limit in terms of inputs use. As a result, they expect new approaches and/or new technical concepts to keep on progressing



“Climate FieldView™ uses a proprietary process to deliver consistent, high-quality satellite images so farmers and technicians can identify in-season challenges and take action to protect yield”

MARTIN RAND (COMMERCIAL
DIRECTOR OF VITALFIELDS, ESTONIA)

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"Overall, farmers feel that they have reached a limit in terms of inputs use. As a result, they expect new approaches and/or new technical concepts to keep on progressing and innovating"

THIERRY DARBIN (PRECISION AGRICULTURE CHIEF OFFICER, INVIVO AGRICULTURE, FRANCE)

and innovating". "You cannot put new wine in old bottles", Mr Darbin said. With this, he tried to illustrate the decreasing trend in the use of decision support tools observed in the last years. However, Precision Ag tools are gaining adepts little by little, because there is an increasing awareness about site-specific variability. "Why use the same rate everywhere when soils & crop yields are so variable in the field?" In this line, another recent market study based on 6,000 French farmers revealed that 69% of the farmers have already implemented some PA strategies in their farms, but 96% of those have not yet resorted to applying variable rates. From the surveys carried out about Precision Ag, several key aspects may be highlighted: a) farmers prefer local, close support, "somebody that already knows me and my farm"; b) soil is recognized as the main source of variability, "everything starts from soils"; c) farmers should understand, adhere and be at the centre of the system; d) a full and turnkey solution is needed, "from intra-field soil diagnosis, zoning, characterization, variable-rates application, to hotline and

financial facilities"; and e) PA is a process of continuous improvement for a visible progress.

A mode of conclusion, Mr Darbin stated that there is a real and strong interest in implementing PA from French farmers. This will be the best way to keep on progressing while meeting the expectations of society (higher yields, better products, sustainable agriculture and environmentally respectful). Then, the real success of PA will pass by bringing stakeholders together, adapt existing agronomic

models and decision-making rules to the new technological paradigm, and by producing simple overall and coherent solutions.

PRECISION AGRICULTURE: WHY NOT (YET) A HUGE SUCCESS?

After 25 years of PA, "why is Precision Agriculture not (yet) a huge success?" This is the big question that Mr Andrej Mertelj (CEO, Datalab Agro AG, Switzerland) launched the audience of the 15th New Ag International Conference in Berlin. Actually, he defined the

moment as the "battle for the eyeballs".

"The battle for the eyeballs" was a term introduced years ago by Andy Grove, Intel's former chief executive, when Intel, the world's largest chipmaker, launched the Pentium MMX microprocessor. He described the ensuing battle for the home market as "the battle for the eyeballs". Now it is the same with Precision Ag: many independent solutions by small or big companies working initially (or not) in the agricultural sector are being launched



Figure 11: FieldView™ is a Precision Ag tool by Climate Corporation to have all data in one place, provide simplified field insights to farmers and optimize the agronomic decisions.

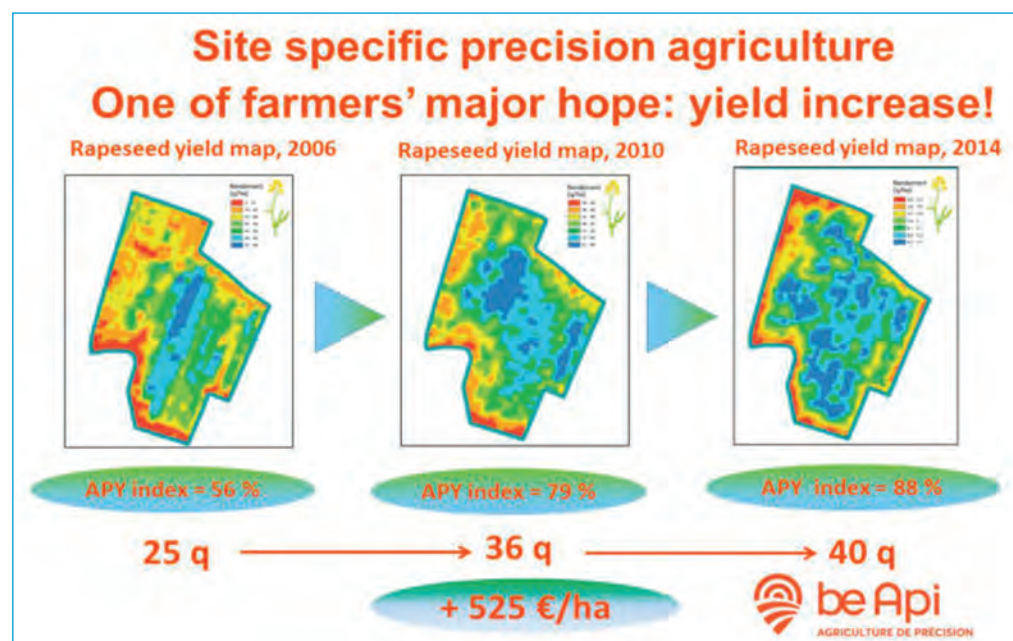


Figure 12: Farmers want to increase yields and with Precision Ag these can be increased. Nevertheless, big changes are not probable in the short term. Changes are progressive according the measures implemented and the year to year monitoring.



"Vendor locks should not be a strategy anymore. Share the data!"

ANDREJ MERTELJ (CEO, DATALAB AGRO AG, SWITZERLAND)

for a huge potential market. However, many farmers that are being offered PA services do not yet see clearly the benefits of implementing PA in their farms. Uncertainties and indecision are



Figure 13: The “battle for the eyeballs” in Precision Ag. It may reflect why, after 25 years, PA is not a success (yet).

being produced in farmers when they are pushed to adopt one or another solution. For example, farmers say: "I want to be able to transfer the data from red to yellow tractor, but they have different protocols"; "I will buy the service or I am willing to pay if I can see a proven benefit" (but remember, you cannot expect results overnight

with PA); or "I don't like paying for something which is going to be outdated within a few months". This mess or lack of standard data, protocols, etc., results in a high cost of opportunity. Mr Mertelj gave some examples of this in his presentation. For example, it took 9 years of hard negotiations to standardize the ISOBUS connector. "Vendor

locks should not be a strategy anymore. Share the data!" Also, the public administrations should make the data freely accessible. This, together with the definition of standards, should not be anymore an obstacle for the real adoption of PA. "We don't have such luxury (to wait for long time to establish the standards) anymore!" ■

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